SIEMENS

ARCADIS Varic / Orbic

SP

Adjustment

System

Main System / Adjustment

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Tools, Test Equipment and Aids

NOTE

All tools, test equipment and aids with the exception of those marked "*", are listed along with their specifications in the STC (Service Tools Catalogue).

- Standard tool kit*
- Multimeter Digital
  e.g. "Fluke 8060 A" — Part No. 97 02 101 Y4290
- Oscilloscope > 50 MHz
  e.g. Fluke CombiScobe PM 3390 A — Part No. 99 00 861 Y3155
- Dose measurement device
  e.g. PTW-DALI* — no longer in ARTD
  or PTW-NOMEX* — no longer in ARTD
  or PTW-DIADOS — Part No. 97 17 612 Y0388
- Protective conductor meter
  e.g. tester Unimed 1000 — Part No. 51 38 727 Y0766
- 1 set of radiation filters — e.g. Part No. 97 98 596 G5321
- Center cross — e.g. Part No. 96 60 051 RE999

Safety Information and Safety Measures

NOTE

When performing service work and tests, please observe:

- the product-specific information in the document Replacement of Parts, SPR2-310.841.01..

- the safety information in TD00-000.860.01.. in the Register in the ARCADIS binder, as well as

- the safety information contained in the ARTD, Part 2.

⚠WARNING

Dangerous X-radiation during checks and adjustment work steps.

Risk of death or serious physical injury.

➪ **For checks and adjustments that must be performed with radiation switched on, the prescribed radiation safety measures must be observed; if necessary, wear radiation protective clothing (see also ARTD-002.731.02.. and ARTD-002.731.38.. General Guidelines for Technical Service). These checks and adjustments are explicitly labeled on the following pages with the radiation warning symbol** **.**

Symbols

This symbol means “X-ray”, checks and adjustments that must be performed with radiation ON.

General information for the following adjustments

1. Switch on the ARCADIS system.
2. In the application menu bar, click on <Options>-<Service>-<Local Service>.
3. Enter the (6-digit) password.
4. Click on <**OK**>.
5. Click on <**Main System**>.
6. Select the ARCADIS system type.
7. Click on <**Next**>.

The following adjustments are available:

- Generator Adjustment
- Generator Adjustment Check
- Load Counter
- Image Rotation
- Collimator X-iris
- Display X-iris
- Collimator Slot Diaphragm
- Display Slot Diaphragm
- Dose Area Product
- Air Kerma
- Dose Rate Adjustment / Checking the Dose Rate in Automatic Mode

These adjustments are described on the following pages in the above-mentioned sequence in this document, and they are also available in the system. A <**click here**> link is available on the pages where adjustments are possible. When you click on <**click here**>; the relevant adjustment description page will come up on the monitor. Always place the description page on the right monitor.

NOTE

After making changes under "Configuration" or "Adjustment", a backup of the new values is required.

NOTE

After you enter the service menu, the currently selected dominant is shown as a circle in the radiation field.

Abbreviations

DAP	Dose area product
DAP int	Dose area product, internal measurement from system
DAP ext	Dose area product, external measurement from dose meter
K_a int	Dose (air kerma), internal measurement from system
K_a ext	Dose (air kerma), external measurement from dose meter
$\Delta K_a/\Delta t$ int	Dose rate (air kerma), internal measurement from system
$\Delta K_a/\Delta t$ ext	Dose rate (air kerma), external measurement from dose meter
CFC	Continuous FluorosCopy
PFC	Pulsed FluorosCopy

Generator Adjustment

1. Register an emergency patient to allow radiation release.
2. Place 2.1 mm Cu on the radiation exit port of the single tank.
3. Click on <**Go**>.
   - ➪ Action bar: “start fluoroscopy”

4. **Start fluoro**
   - ➪ Action bar: “continue fluoro”
   - ➪ Status bar: “kV- offset-learning”
   - ➪ Status bar: “kV- learning done”
   - ➪ Action bar: “stop fluoroscopy”
5. **Stop fluoro**
   - ➪ Status bar: “generator learning”
   - ➪ Action bar: “start fluoroscopy”

6. **Start fluoro**
   - ➪ Action bar: “continue fluoro”
   - ➪ Status bar: “warmup” (~ 8 minutes)
   - ➪ Status bar: “filament correction”
   - ➪ Status bar: “learning pushfactor”
   - ➪ Status bar: “gen. learning done”
   - ➪ Action bar: “stop fluoroscopy”
7. **Stop fluoro**
8. Click on <**Save**>.
   - ➪ A window appears: “Main system values were successfully saved” --> click on <**OK**>.
9. Click on “**>**” for the next page (multiple exposure) and perform a generator adjustment check.

Generator Adjustment Check

1. Click on <**Go**> to activate “Multiple Exposure”.
   ➪ The system is now in direct exposure mode.
2. Select 81 kV with the kV+ / kV- keys and 8 mAs with the mAs+ / mAs- keys
3. Connect oscilloscope channel 1 to D1.X46, ground at 0V for "mA ist".
   ➪ Set the sensitivity to 2 V / Div. (1 V = 2.5 mA).
4. Connect oscilloscope channel 2 to D1.X48, ground at 0 V for "kV ist".
   ➪ Set the sensitivity to 2 V / Div. (1 V = 20 kV)
   ➪ Set the time to 5 ms / Div.

5. Release an exposure with the hand switch and store the oscillogram.
6. Evaluate the oscillogram (Fig. 1 / p. 9), tolerance for the mA curve:
   ➪ The tube current must reach 13 mA ± 1.5 mA within 3 ms
7. Click on <**Go**> to stop the direct exposure mode.
8. If the tube current (Fig. 1 / p. 9) exceeds the specified tolerances, the generator adjustment and the mAs counter adjustment must be repeated.

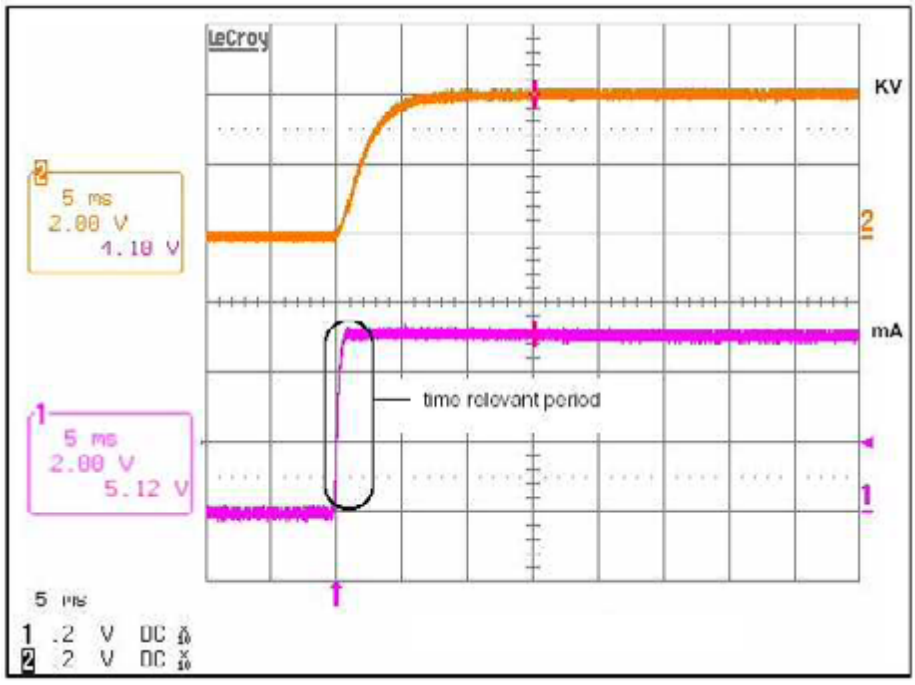

Fig. 1: Generator adjustment

Load Counter

Store load counter data

1. Switch on the system and insert a CD in the CD-ROM drive.
2. Open the service application.
3. Click on <Reports> and <Configuration Online>.
   ➪ A new report of the main system will be generated.
4. Click on <Exit> to close this window.
5. Click on <Eventlog> and <Burn Log-Files> in the service menu.
   ➪ A window appears “Do you want to burn a newly created developer SaveLog too?”.
6. Click on <Yes> , <Select All> and <Burn Files>.
   ➪ All data will be burned on the CD, including the actual load counter data and the event log.

NOTE

Replacing the D1 board (main system) sets the “reset counter” and the load units to “0”.

Load counter reset

1. Install the new tube and enter the new single tank serial number under <Main System>-<Configuration>-<Load Counter>.
2. Under “Adjustment” click on <Load Counter>.
3. Click on <**Go**> to reset the load counter.
   ➪ A load counter reset is only possible after the new single tank serial number is entered under <Main System>-<Configuration>-<Load Counter>.
4. Click on <**Go**> to end the reset of the load counter.
   ➪ The main system reboots
   ➪ A error message appears “Single Tank is not equal...”

NOTE

After a load counter reset, the serial number of the new tube is not shown under <Main System>-<Adjustment>-<Load Counter> until a “Generator Adjustment” has been performed.

5. Under “Adjustment” click on <Generator Adjustment> and perform a “Generator Adjustment”
6. After the “Generator Adjustment” check whether the “Load Counter” reset has been carried out.
   ➪ Check under <Main System>-<Adjustment>-<Load Counter> to see if the “single tank serial number” has changed to the new tube serial number.

NOTE

Send the burned CD together with the single tank and the tube questionnaire back to the factory (as required by the terms of the warranty).

Image Rotation

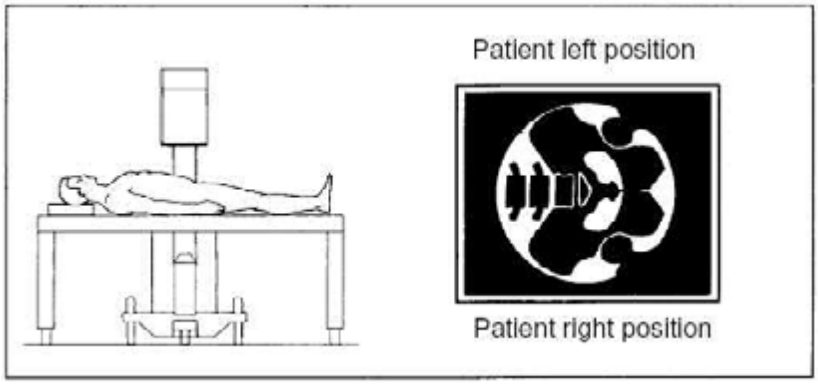

Fig. 2: Image rotation

Fig. 3: Image_rotation

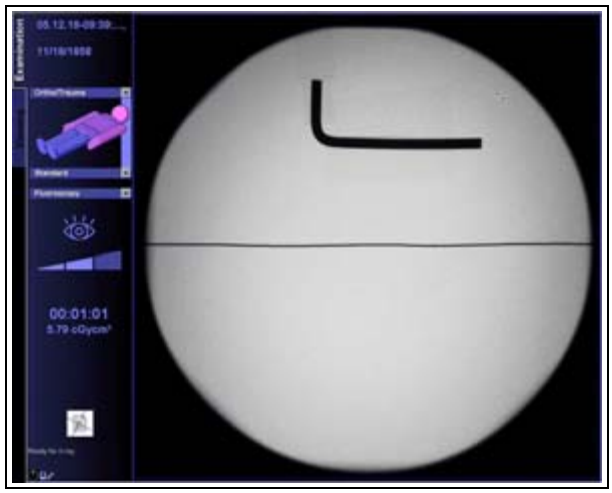

Fig. 4: Image position

Adjustment

1. Register an emergency patient to allow radiation release.
2. Manually set the image rotation to the 0 degree position at the control console.
   ➪ See display for image rotation at the control console.
3. Attach an Allen key and a piece of solder wire to the image intensifier as shown in (Fig. 3 / p. 11).
4. Click on <**Go**>.
   ➪ Status bar: Init (Disable Limits) --> running --> success
5. Briefly release fluoro and then use the PC mouse to rotate the LIH image on the monitor screen into the 0 degree position.
   ➪ The image (left/right / up/down) corresponds to (Fig. 4 / p. 11).
6. Click on <**Go**>.
   ➪ Status bar: 0 Degree Position --> running --> success

7. Click on <**Go**>.
   - ➪ Status bar: Init Off & Store Positions --> running --> success A window appears: Calibration is finished --> confirm with <OK>.
   - ➪ The main system restarts.
8. Manually set the image rotation to the 0 degree position at the control console.
   - ➪ See display for image rotation at the control console.

9. Briefly release fluoro.
   - ➪ The image should now display in the correct 0 degree position (Fig. 4 / p. 11); if not, repeat adjustment.
10. Click on “**>**” for the next page and click on <**Finish**>.

Collimator X-iris

Prerequisites

- Use the X-iris keys at the control console for the adjustment.
  - ➪ At least 2 blades of the X-iris must be visible.
  - ➪ For countries with DHHS regulation, 8 blades must be visible.

Adjustment

1. Register an emergency patient to allow radiation release.
2. Attach the centering cross in the center of the image intensifier input screen.
3. To deselect the circle mask, select "**Transparent**" and click on <**Activate**>.
4. Click on <**Go**>.
   - ➪ Status bar: Init (LimitsOff/Autosearch) --> running --> success

I.I. Full Format Position

5. Release fluoro and adjust the X-iris so that the blades are still visible along the edge of the I.I.

NOTE	**For units with air kerma display, a default value of 200 mm for "X-iris I.I.-Full Format Position" is used for software calculation. Enter different diameter settings under <Configuration>-<Main System>-<Air Kerma> "X-Iris Open Position in mm".**

6. Stop fluoro and click on <**Go**>
   - ➪ Status bar: I.I.-Full Format Position --> running --> success

I.I. Zoom Format Position

7. Release fluoro and adjust the X-iris so that the blades are still visible along the edge of the I.I .
8. Stop fluoro and click on <**Go**>.
   - ➪ Status bar: I.I.-Zoom Format Position --> running --> success
   - ➪ CEX position is automatically selected. Wait until the "X-iris open button LED" is on.

CEX Position

9. Click on <**Go**>.
   - ➪ Status bar: CEX Position --> running --> success

Closed Position

10. Release fluoro and close X-iris until the X-ray field is 43 mm. Tolerance: + 2 mm/ -3 mm.
    - ➪ See attached centering cross.

NOTE

For units with air kerma display it is important for software calculation that the X-iris closed position is adjusted accurately.

11. Stop fluoro and click on <**Go**>.
    - ➪ Status bar: Closed Position --> running --> success

Init Off & Store Values

12. Click on <**Go**>.
    - ➪ Status bar: Init Off & Store Positions --> running --> success
    - ➪ A window appears: "Calibration is finished..." --> confirm with <**OK**>.
    - ➪ Main system restarts.
13. Click on "**>**" for the next page.
    - ➪ The main system restarts and the circle mask switches back to on.
    - ➪ The X-iris positions can be configured manually here.
14. Configure the "Zoom Procedure" on this page per the country regulations or the customer's preference.
15. Click on <**Finish**>.
16. Check the adjustment and repeat if necessary.

Display X-iris

Prerequisites

- Use the X-iris keys at the control console for the adjustment.
- “Collimator X-Iris” has been adjusted correctly.

Adjustment

1. Register an emergency patient to allow radiation release.
2. Click on <**Go**>.
   ➪ Status bar: Init --> running --> success

Open Pos. I.I. Full Format

3. Briefly release fluoro for the LIH image.
4. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
5. Click on <**Go**>.
   ➪ Status bar: Open Pos-. I.I. - Full Format --> running --> success

Close Pos. I.I. Full Format

6. Briefly release fluoro for the LIH image.
7. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
8. Click on <**Go**>.
   ➪ Status bar: Close Pos. I.I. - Full Format --> running --> success

Close Pos. I.I. Zoom Format

9. Briefly release fluoro for the LIH image.
10. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
11. Click on <**Go**>
    ➪ Status bar: Close Pos. I.I. - Zoom Format --> running --> success

Open Pos. I.I. Zoom Format

12. Briefly release fluoro for the LIH image
13. Adjust the graphic display until the graphic circle is aligned with the circle size of the X-iris diaphragm.
14. Click on <**Go**>.
    ➪ Status bar: Open Pos. I.I. - Zoom Format --> running --> success

Open Pos. I.I. Zoom Format

15. Click on <**Go**>.
    - ➪ Status bar: Init Off & Store Values --> running --> success
    - ➪ A window appears: "Calibration is finished..." --> confirm with <**OK**>.
    - ➪ The main system restarts.
16. Click on "**>**" for the next page and click on <**Finish**>.
17. Check the adjustment and repeat if necessary.

Collimator Slot Diaphragm

Prerequisites

- Image rotation has been adjusted correctly.
- Use the slot diaphragm keys at the control console for the adjustment.
- Image reversal functions are disabled.
- Use 2.1 mm Cu as prefilter.

Adjustment

1. Register an emergency patient to allow radiation release
2. Click on <**Go**>.
   ➪ Status bar: Init (LimitsOff/Autosearch) --> running --> success

0 Degree Position

3. Release fluoro and move the slot diaphragm to the vertical position (↑) on the monitor.
4. Stop fluoro and click on <**Go**>.
   ➪ Status bar: 0 Degree Position --> running --> success

I.I. Full Format Position

5. Release fluoro and open the slot diaphragm so that the blades begin to disappear at the edge of the image.

NOTE	**For units with air kerma display it is important for software calculation that the slot diaphragm in "I.I. - Full Format Position" is adjusted accurately to the edge of the visible I.I. field.**

6. Stop fluoro and click on <**Go**>.
   ➪ Status bar: I.I.-Full Format Position --> running --> success

I.I. Zoom Format Position

7. Release fluoro and open the slot diaphragm so that the blades begin to disappear at the edge of the image.
8. Stop fluoro and click on <**Go**>.
   ➪ Status bar: I.I.-Zoom Format Position --> running --> success

Init Off & Store Position

9. Click on <**Go**>.
   - ➪ Status bar: Init Off & Store Position --> running --> success
   - ➪ A window appears: Calibration is finished --> confirm with <**OK**>.
   - ➪ The main system restarts.
10. Click on "**>**" for the next page and click on <**Finish**>.
11. Check the adjustment and repeat if necessary.

Display Slot Diaphragm

Prerequisites

- “Collimator Slot Diaphragm” has been adjusted correctly.
- Use the slot diaphragm keys at the control console for the adjustment.
- Use 2.1 mm Cu as prefilter.

Adjustment

1. Register an emergency patient to allow radiation release.
2. Click on <**Go**>.
   - ➪ Status bar: Init --> running --> success
   - ➪ Press the collimator X-iris “open button” at the control console to open the X-iris completely.

Open Pos. I.I. Full Format

3. Briefly release fluoro for the LIH image.
4. Adjust the display lines on the monitor until the lines are aligned with the front edges of the slot diaphragm blades.
5. Click on <**Go**>.
   - ➪ Status bar: Open Pos. I.I. - Full Format Position --> running --> success

Close Pos. I.I. Full Format

6. Briefly release fluoro for the LIH image.
7. Adjust the display lines on the monitor until the lines are aligned with the front edges of the slot diaphragm blades.
8. Click on <**Go**>.
   - ➪ Status bar: Close Pos. I.I. - Full Format --> running --> success

Close Pos. I.I. Zoom Format

9. Briefly release fluoro for the LIH image.
10. Adjust the display lines on the monitor until the lines are aligned with the front edges of the slot diaphragm blades.
11. Click on <**Go**>.
    - ➪ Status bar: Close Pos. I.I. - Zoom Format --> running --> success

Open Pos. I.I. Zoom Format

12. Briefly release fluoro for the LIH image.

13. Adjust the display lines on the monitor until the lines are aligned with the front edges of the slot diaphragm blades.
14. Click on <**Go**>.
    - ➪ Status bar: Open Pos. I.I. - Zoom Format --> running --> success

Init Off & Store Position

15. Click on <**Go**>.
    - ➪ Status bar: Init Off & Store Position --> running --> success
    - ➪ A window appears: “Calibration is finished...” --> confirm with <**OK**>.
    - ➪ The main system restarts.
16. Click on “>” for the next page and click on <**Finish**>.
17. Check the adjustment and repeat if necessary.

Dose Area Product

DAP chamber test (Wellhöfer) / DAP chamber adjustment (PTW)

1. Decide which DAP chamber is installed, “Wellhöfer” or “PTW”, see path <Main System>-<Configuration>-<Options>.
   - ➪ DAP camber resolution 0.01cGy cm*cm = “**Wellhöfer**” DAP
   - ➪ DAP camber resolution 1.0 cGy cm*cm = “**PTW**” DAP
2. Continue with the corresponding description “Wellhöfer...” or “PTW...”.

NOTE

A chamber gain adjustment is necessary if the DAP accuracy check or the air kerma accuracy check is not in tolerance.

Wellhöfer - chamber gain adjustment

1. Register an emergency patient to allow radiation release.
2. Select dose rate for air kerma or dose for DAP, depending on the configuration, at the external dose meter.

NOTE

Make sure that 2.5mm AL filtration at the external dose meter is selected during the chamber gain adjustment.

3. Attach the small dose measurement chamber (1cm^3) into the center of the I. I. grid.
4. Select I.I. full format and open the collimator X-iris and the slot diaphragm to the maximum position.
5. Select the following exam set to get as a result the HC2 control curve:
   - ➪ Ortho/Trauma; Standard; Body reg = HIP; Fluoroscopy

6. Briefly release fluoro, select the <kV STOP> key and 70 kV with the kV + / - buttons on the console.

7. Release fluoro and compare the dose rate from the external dose meter to the internal monitor display.
   - ➪ Use correction factors and calculations described under “DAP accuracy check” or under “Air kerma accuracy check”.
   - ➪ Calculate the external dose meter's deviation from the internal monitor display.**Difference = [(int. value) - (ext value)] / (ext value)**
   - ➪ The maximum allowed difference is **± 0.25** (± 25%).

8. Remove the cover from the single tank.

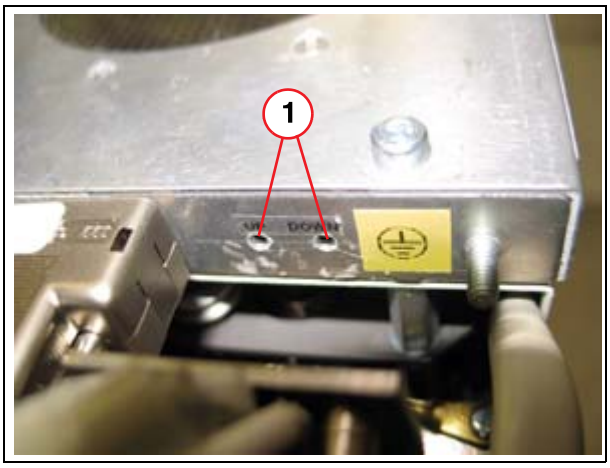

Fig. 5: Wellhöfer_DAP

9. Adjust the chamber gain by pushing the up or down button for at least 200 ms for each push at the chamber (1/Fig. 5 / p. 22).
   - ➪ Use a small Allen key (diameter 0.5 - 1.0 mm) to push the “UP” or DOWN” button (e. g. 20 x push down = -10%).
   - ➪ “DOWN” = 0.5 % reduction of gain per push.
   - ➪ “UP” = 0.5 % increase of gain per push.
10. Reinstall the single tank cover, check the dose rate again and perform a “Wellhöfer - chamber test”.

NOTE **A “Wellhöfer chamber test” is necessary after a “Wellhöfer chamber gain adjustment”.**

Wellhöfer - chamber test

1. Click on <**Go**> to start the chamber test.
   - ➪ Status bar: success
   - ➪ Wait about 3 seconds for the constant readout
2. Note the displayed “DAP” or “Air Kerma” from the ARCADIS monitor depending on the configuration (path: <Configuration>-<Imaging System>-<Display Settings>).
   - ➪ With “DAP” configured, the monitor indication is “ xx.xx $cGcm^2$ ”.
   - ➪ With “Air Kerma” configured, the monitor indication is “ xxxx.x mGy ”.
3. Click on <**Go**> again to stop the chamber test.
   - ➪ Status bar: success
   - ➪ Window appears: Calibration is finished --> confirm with <**OK**>.
   - ➪ The main system restarts.

4. Enter the chamber constant from the monitor acquisition task card under <Main System>-<Configuration>-<Option> “DAP chamber resolution”.
   - ➪ With “DAP” display: Multiply the monitor value by 100 and enter the 4 digits (e. g. 49.97 x 100 = 4997).
   - ➪ With “Air Kerma” display: Enter the first 4 digits from the monitor value. (e. g. 4997.2 = 4997).
5. Click on <**Finish**>.
6. Continue with “DAP accuracy check” or “Air Kerma accuracy check”.

PTW - chamber test and adjustment

1. Read out the TW constant from the previous page or under <Main System>-<Configuration>-<Options>.
2. Click on <**Go**> to start the DAP test.
   - ➪ Status bar: success
3. Read out the DAP constant from the ARCADIS monitor at the acquisition task card.
4. Click on <**Go**> again to stop the DAP test.
   - ➪ Status bar: success
   - ➪ Window appears: Calibration is finished --> confirm with <**OK**>.
   - ➪ The main system restarts.
5. Compare these two values.
   - ➪ The DAP constant TW and the value from the ARCADIS monitor acquisition task card should be equal.

Fig. 6: Dose Area Product Adjustment

6. If necessary, adjust the potentiometer at the DAP chamber (Fig. 6 / p. 23).
   - ➪ Clockwise for a lower TW value.
   - ➪ Counterclockwise for a higher TW value.
7. Repeat the DAP test and the potentiometer adjustment until the two values are equal.
8. Click on **<Finish>.**
9. Continue with “DAP accuracy check”.

DAP accuracy check

Prerequisites

1. Register an emergency patient to allow radiation release.

NOTE

The “DAP accuracy check” is only possible if the “Dose Area Product” is configured under <Configuration>-<Imaging System>-<Display Settings>.

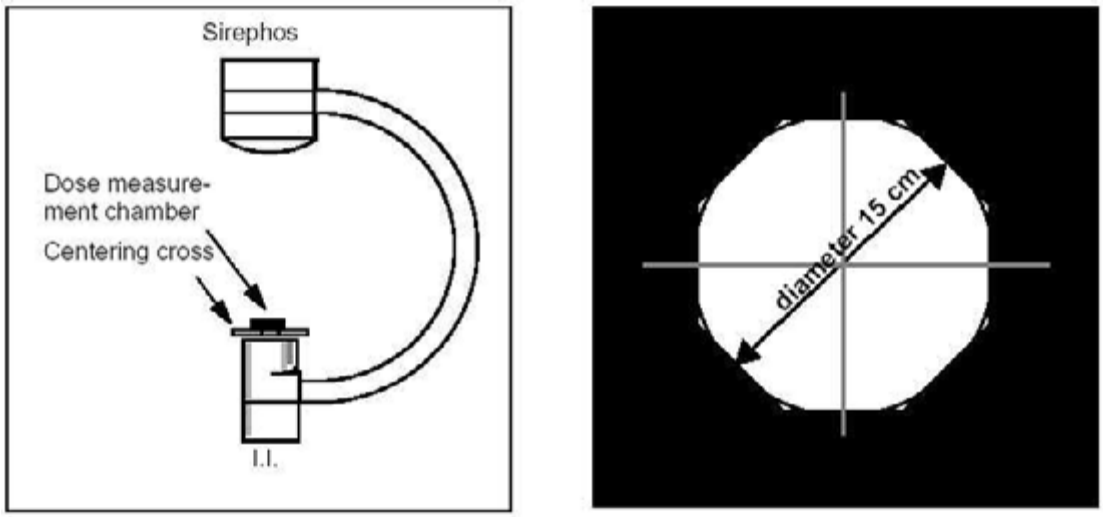

Fig. 7: Accuracy of the Dose Area Product

2. Attach and center the centering cross on the I.I. (Fig. 7 / p. 24).
3. Briefly release fluoroscopy and adjust the collimator X-iris on the X-ray field to a diameter of approx. 15 cm (Fig. 7 / p. 24).
4. Record the diameter of the octagonal area of the radiation field and remove the center cross.
5. Attach the small dose measurement chamber (1cm^3) into the center of the I. I.

NOTE

Make sure that the dose meter is adjusted for about 2.5mm AL filtration during the “DAP accuracy check”.

Accuracy check

1. Briefly release fluoroscopy, select the <kV STOP> key and enter 70 kV at the control console.
2. Note the measured DAP on the ARCADIS monitor as **# 1** and set the external dose meter to "0".
3. Release fluoroscopy until a measured dose (**K_a ext**) of 4 - 5 mGy is displayed at the external dose meter and note this value.
4. Note the area dose product (in $cGycm^2$) displayed on the ARCADIS monitor as **# 2** and subtract **# 1** from **# 2** to get the dose (**DAP int**) to be compared to the external dose meter.
5. Calculate the measured dose (**K_a ext**) to the comparable dose area product (**DAP ext**) in $cGycm^2$:
   - ➪ **DAP ext =** (**K_a ext** in mGy) x (**diameter ^{2}** in cm) x (**0.829**) **/ 10**

NOTE	**0.829 is the area calculation factor for the octagon.**

6. Calculate the difference between the measured and displayed dose area product:
   - ➪ **Difference = [(DAP int) - (DAP ext)] / (DAP ext)**
7. The maximum allowed difference is **± 0.25** (± 25%).
   - ➪ PTW dose meter: For differences > +0.25 and < -0.25, perform the “PTW - chamber test and adjustment”.
   - ➪ Wellhöfer dose meter: For differences > +0.25 and < -0.25, perform the “Wellhöfer - chamber gain adjustment”.

Air Kerma

NOTE

The air kerma accuracy check is only possible if the resolution 0.01 cGy cm*cm/Pulse is configured under <Main System>-<Configuration>-<Options>-<Resolution> and "Air Kerma" is configured under <Configuration>-<Imaging System>-<Display Settings>.

Prerequisites

1. Register an emergency patient to allow radiation release.
2. Select dose rate at the external dose meter and attach the small dose measurement chamber ($1cm^3$) to the center of the I. I. grid.

NOTE

Make sure that 2.5mm AL filtration at the external dose meter is selected during the air kerma accuracy check.

3. Select I.I. full format and open the collimator X-iris and the slot diaphragm to the maximum position.
4. Select the following exam set to get as a result the HC2 control curve:
   - ➪ Ortho/Trauma; Standard; Body reg = HIP; Fluoroscopy
5. Read out the reference location factor (RL) under <Main System>-<Adjustment>-<DAP/Air Kerma>.
   - ➪ RL = **685** (Varic + Orbic; 300 mm to I.I.) --> Factory default
   - ➪ RL = **487** (Varic; 150 mm to isocenter) --> Use only upon customer request
   - ➪ RL = **490** (Orbic; 150 mm to isocenter) --> Use only upon customer request
6. SID for Varic and Orbic = 1005 mm
   - ➪ SID to the grid surface: 1005 mm - 20 mm = **985** mm

NOTE

The correction factor Cx is required because the measurement chamber is attached to the grid instead of "300 mm to I.I." or "150 mm to isocenter".

7. Calculate the correction factor (Cx): $\mathbf{Cx = (985 / RL)^2}$
   - ➪ Cx with RL "685" = **2.07**
   - ➪ Cx with RL "487" = **4.09**
   - ➪ Cx with RL "490" = **4.04**

Accuracy check

1. Briefly release fluoro, select the <kV STOP> key and 70 kV with the kV + / - buttons on the console.

2. Release fluoroscopy and note after approx. 10 seconds fluoro the dose rate from the dose meter as "$\Delta K_a/\Delta t$ **ext**" and the displayed dose rate at the monitor as "$\Delta K_a/\Delta t$ **int**" and stop fluoro.

3. Calculate the difference between the dose rate from the external dose meter multiplied by Cx and the internal dose rate, displayed at the monitor, converted to µGy/s:
   - ➪ Step 1: Calculate monitor value ($\Delta K_a/\Delta t$) int from (mGy/min) to (µGy/s): (Δ**K$_a$/Δt int** in mGy/min) **x** (**16.66**) = (Δ**K$_a$/Δt int** in µGy/s)
   - ➪ Step 2: Multiply the external dose rate ($\Delta K_a/\Delta t$ ext) by factor (Cx): (Δ**K$_a$/Δt ext) x** (**Cx**) = (Δ**K$_a$/Δt ext _Cx**)
   - ➪ Step 3: Calculate the difference from ($\Delta K_a/\Delta t$ int) to ($\Delta K_a/\Delta t$ ext _Cx): Difference = **[(ΔK$_a$/Δt int) -** (Δ**K$_a$/Δt ext _Cx)] /** (Δ**K$_a$/Δt ext _Cx**)
4. Evaluate the measurement; the maximum allowed difference is **± 0.35** (± 35%).
   - ➪ For differences > + 0.35 and < - 0.35, an “air kerma dose matching” adjustment is necessary.
5. Release the kV-stop key.
6. Repeat the “air kerma accuracy check” twice in full format with the following conditions:
   - ➪ **1**. Slot diaphragm = maximum open. X-iris opening diameter = approx. 16 cm (measured on the monitor).
   - ➪ **2**. X-iris = maximum open. Slot diaphragm opening diameter = approx. 16 cm (measured on the monitor).

Air kerma dose matching

1. Attach and center the centering cross on the I.I.

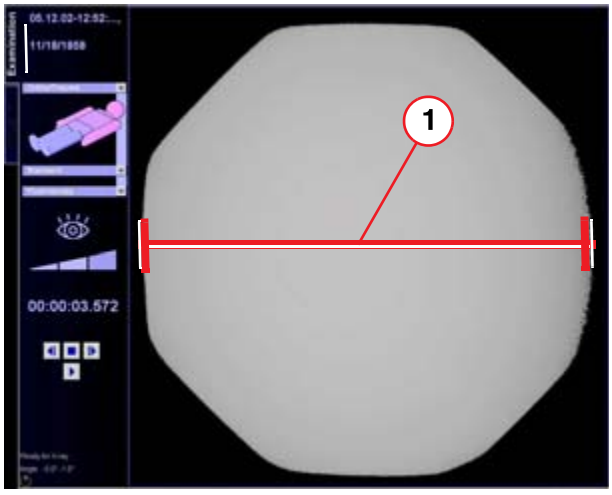

Fig. 8: diameter_x iris

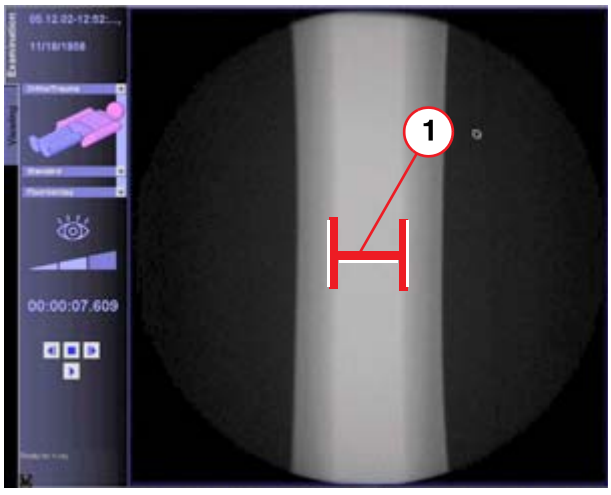

Fig. 9: diamentor_slot_diaph

2. Briefly release fluoro and measure the maximum and minimum diameter of the visible X-ray field in full format (1/Fig. 8 / p. 27).
   - ➪ Open the X-iris to the maximum position in full format and note the diameter from the centering cross.
   - ➪ Close the X-iris to the minimum position in full format and note the diameter from the centering cross.

3. Perform the collimator slot diaphragm adjustment under <Main System>-Adjustments>-<Collimator slot diaphragm>.
   - ➪ Make sure that the front edge of the slot diaphragm is accurately adjusted to the edge of the I. I.
4. Briefly release fluoro and measure the minimum distance between the front edges of the slot diaphragm in full format (1/Fig. 9 / p. 27).
   - ➪ Use 2.1mm Cu as prefilter to make the front edges visible.
   - ➪ Close the slot diaphragm to the minimum position in full format and note the diameter from the centering cross (front edge to front edge).
5. Insert the previously noted “open” and “closed” X-iris values and the “closed” slot diaphragm value under <Main System>-<Adjustment>-<Air Kerma> and click on <Save>.
   - ➪ X-Iris Open Pos. in mm
   - ➪ X-Iris Close Pos. in mm
   - ➪ Slot diaphragm Close Pos. in mm (1/Fig. 9 / p. 27).
   - ➪ Slot diaphragm Open Pos. = remains at the default value
6. Remove the center cross and repeat the “air kerma accuracy check”.

NOTE

If the air kerma dose matching was not successful, perform the "Wellhöfer chamber gain adjustment" and the “Wellhöfer chamber test”. Then repeat the air kerma accuracy check.

Dose Rate Adjustment

Explanation of the status bar during the "Dose Rate Adjustment".

Auto Regulation	Indicates the current status of the automatic adjustment. (NOT READY / NOT ACTIVE / ACTIVE / DONE / STOP fluoroscopy)
Brightness Deviation	Shows the difference in the actual brightness value minus the nominal brightness value.
Control Curve	Shows the currently selected fluoro curve. **DA CFC 75 kV** is used for dose rate adjustment.
Adjustment	Shows the operating control mode. (Generator / Camera Iris / Stop)
I.I. Zoom Status	Shows the current I.I. format (full format / zoom)
Dose rate	Shows the dose rate selected. (LOW / MID / HIGH)
TV -Iris Actual Position	Shows the actual TV iris value.
TV -Iris Nominal Value	Shows the stored or nominal TV iris value from the learning phase. For doserate "LOW" the brightness deviation value can be higher than ± 10 and also the resulting dose can be higher. For dose rate "MID" and "HIGH" brightness, the deviation value should be 0 ± 10.

Prerequisites

The grid remains on the I. I.

Filter for X-ray tube output is **25 mm Al** and **1.2mm Cu**.

You can alternatively use **2.7mm Cu** if no aluminum is available.

Dose rate correction factors

Correction factor for the small dose measurement chamber is 1.00.

Correction factor for the large dose measurement chamber is 1.06.

Grid correction factor is 1.50.

➪ It is preferable not to remove the grid from the I.I.

Correction factor with large chamber and grid is 1.59.

Dose rate 23 cm I.I.

Format (Cu Filter)	Correction factor	Dose rate in nGy/s		
		LOW	MID	HIGH
Full format (2.7mm Cu)	0.00 - without grid	110	185	370
	1.50 - grid + small chamber	**165**	**277**	**555**
	1.59 - grid + large chamber	**175**	**294**	**588**
Zoom (2.7mm Cu)	0.00 - without grid	157	262	523
	1.50 - grid + small chamber	**235**	**393**	**784**
	1.59 - grid + large chamber	**250**	**416**	**831**

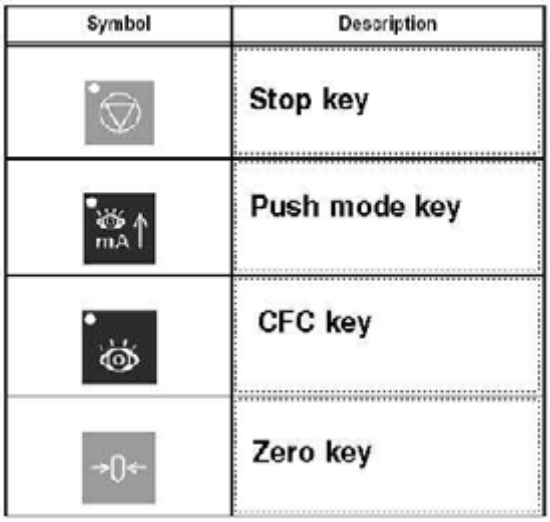

*Fig. 10: Symbol_table_*

Adjustment

1. Register an emergency patient to allow radiation release.
2. Open the service application.
   - ➪ The open service application makes the dominant circle visible.
3. Attach the dose measurement chamber on the I.I. input screen.
   - ➪ If a small chamber is used: Attach chamber in full format and zoom format outside the displayed dominant circle but inside the visible field.
   - ➪ If a large chamber is used: Center the chamber to the displayed in the dominant circle.
4. Place **25 mm Al** and **1.2 mm** Cu, or alternatively **2.7 mm Cu** in front of the collimator.

5. Click on **<Go>** to start the dose rate adjustment and wait until "**NOT ACTIVE**" appears in the status bar "Auto Regulation".
   - ➪ The X-iris and the slot diaphragm open automatically to the maximum outside position.
   - ➪ The DA CFC 75 kV curve is displayed in the status bar “Control Curve”.
   - ➪ I.I. **full format** is selected and displayed in the status bar “I.I. Zoom Status”.

6. **Start fluoro**, wait 5 seconds then press the “**KV STOP**” key (Fig. 10 / p. 30) on the control console.
   - ➪ Continue fluoro.
7. **Adjust dose rate** by using the control console keys.
   - ➪ The target of the dose rate value without correction factor is displayed in the status bar "Dose rate".
   - ➪ Tolerance for the dose rate: **± 5 %**
   - ➪ Use keys [+kV] and [-kV] for 1/2 exposure points.
   - ➪ Use keys [+ mA] and [- mA] for 1/16 exposure points.
   - ➪ The message “**DONE**” appears in the status bar “Auto Regulation”.
8. **Stop fluoro** and press the zero key (Fig. 10 / p. 30) on the control console .
   - ➪ Adjustment for TV iris is carried out.
   - ➪ The message “**STORED**” appears in the status bar “Auto Regulation”.
   - ➪ The brightness deviation value is shown in the status bar “Brightness Deviation”.
   - ➪ For dose rate "**LOW**" the brightness deviation value can be **higher than ± 10**
9. In I. I. **full format**, carry out the same procedure for the dose rate “**MID**” and “**HIGH**”.
   - ➪ For dose rate "**MID**" and "**High**" the brightness deviation value should be 0 **± 10**
   - ➪ Use control console CFC key (Fig. 10 / p. 30) for LOW / MID / HIGH selection.
10. Select **zoom format** and carry out the same procedure for the “**LOW**”; “**MID**” and “**HIGH**” dose rate.
11. After completing the adjustment, click on <**Save**>.
    - ➪ A window appears: “Main system values were successfully saved” --> confirm with <**OK**>.

Checking the Dose Rate in Automatic Mode

Format	Correction factor	Dose rate in nGy/s		
		LOW	MID	HIGH

Full format	0.00 - without grid	110	185	370
	1.50 - grid + small chamber	**165**	**277**	**555**
	1.59 - grid + large chamber	**175**	**294**	**588**
Zoom	0.00 - without grid	n. a.	262	n. a.
	1.50 - grid + small chamber	n. a.	**393**	n. a.
	1.59 - grid + large chamber	n. a.	**416**	n. a.

1. Open the service application.
   - ➪ The open service application makes the dominant circle visible.
2. Attach the dose measurement chamber on the I.I. input screen.
   - ➪ If a small chamber is used: Attach the small chamber for each format outside the dominant circle but inside the visible x-ray field on the I.I.
   - ➪ If a large chamber is used: Attach the large chamber in the center of the dominant circle displayed on the I.I.

3. Briefly release fluoro and choose the Cu prefilter so that **75 kV ± 5** is displayed on the control console.
   - ➪ Preferably, for a low dose, choose the Cu prefilter so that you get a starting point of 70 kV, because with a higher dose the kV will increase.
4. Under <Service>-<Main System>-<Adjustment>-<Doserate> click on <**Go**> and wait until "**NOT ACTIVE**" appears in the status bar "Auto Regulation".
   - ➪ Automatic mode is active.
5. Set the "**HC2**" curve (CFC 550W), displayed in the status bar "Control Curve", by using the control console push mode key (Fig. 10 / p. 30).

6. Check the dose rates LOW / MID / HIGH in full format and dose rate MID in zoom format (refer to the table).
   - ➪ Use control console CFC key (Fig. 10 / p. 30) for dose rate LOW / MID / HIGH selection.
   - ➪ Tolerance in full format for the dose rates LOW, MID and HIGH: **± 15 %**.
   - ➪ Tolerance in zoom format for the dose rate MID: **± 25 %**.
7. After completing the dose rate check, click on <**Cancel**>.

Chapter 2 Accuracy of the Dose Area Product: Tolerance changed from 30 % to 25 %.

34 Changes to previous version